FRED Reports

Progress Report
Marx Creek Spawning Channel
1985-1987

by
Paul Novak
Carol Denton

Number 94

Alaska Department of Fish & Game
Division of Fisheries Rehabilitation,
Enhancement and Development

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ABSTRACT

Construction of a spawning channel at Marx Creek near Hyder, Alaska, was completed in 1985. Chum salmon, *Oncorhynchus keta*, was the targeted species, with pink salmon, *O. gorbuscha*, coho salmon, *O. kisutch*, and Dolly Varden trout, *Salvelinus malma*, also benefiting from habitat and food production stability created by the activity.

Chum salmon adults were transported from the neighboring donor system--Fish Creek. Adult transplants are planned complements to natural escapement and will continue annually for five years. The desired number of annual adult chum salmon spawners is 5,000; this will develop into a self-supporting run after the transplant period.

The channel has 12 sections or cells that are formed by wooden weirs located at intervals varying from 30 m to 305 m. These structures were sited to maintain water depth, upwelling characteristics, and velocity utilizing the existing watershed gradient. Fish-retention fencing was constructed on the weirs to maintain discrete numbers of adult chum salmon per cell in 1985 and 1986. Salmon were allowed to move naturally up to the lowest cell to spawn; weir fencing controlled access into upper cells. Both years' work utilized a 1:1 male/female ratio, but densities varied between the two years of work. In 1985 some 938 females were planted in 5 cells for a 2.18 m^2/female density. In 1986 densities were increased to or above 1.5 m^2/female in 5 cells.

Pre-emergent sampling for brood year 1985 indicated a mean survival of 19.8% from potential egg deposition to advanced alevin stage. Increased spawner density in 1986 resulted in an increased green egg to alevin survival of 25%. Although yolk absorption was monitored to predict emergence timing, photoperiod appeared to have a strong effect on emergence; i.e., many alevins emerged with yolk showing externally.

Emergent chum salmon fry were captured during night periods using a downstream fyke net fitted with a holding box on the distal end. In 1986, 26,892 fry were captured and tagged with coded wire during daylight hours before being released. In 1987, 30,486 were similarly processed. Tagged fry were released at night normally between 10:00 p.m. and 1:00 a.m., after a maximal delay in migration of 24 hours.

Some 2,345,000 eggs were deposited into the 5 cells in 1986 which produced an estimated 455,000 fry. Assuming a 1% survival rate after emigration, 4,550 adults will return to the common-property fisheries and stream. In 1987 potential egg deposition increased to 4,100,000, which produced 1,043,000 fry. Adult returns to the fisheries and stream escapement are predicted to be 10,430 adults from this brood year. Normal age composition for the donor system (Fish Creek) is 10% as age 0.2, 75% as age 0.3, and 15% as age 0.4. Commercial harvest rates are assumed to be extremely high (80%), as adult fish are contributing to the catch in both Canadian and Alaskan fisheries. Evaluation of the spawning channel project will only be possible if coded-wire tag recoveries are made in both countries and at the Marx Creek spawning channel.

INTRODUCTION

Fish Creek, a tributary to the Salmon River near Hyder, Alaska (Figure 1) has had the distinction of producing the largest known chum salmon in Alaska and, perhaps, in North America (Helle 1978). Cooperative habitat rehabilitation activities by the Fisheries Rehabilitation, Enhancement and Development (FRED) Division and the U.S. Forest Service (USFS) have significantly stabilized the watershed and reversed the trend of the declining area chum salmon stocks.

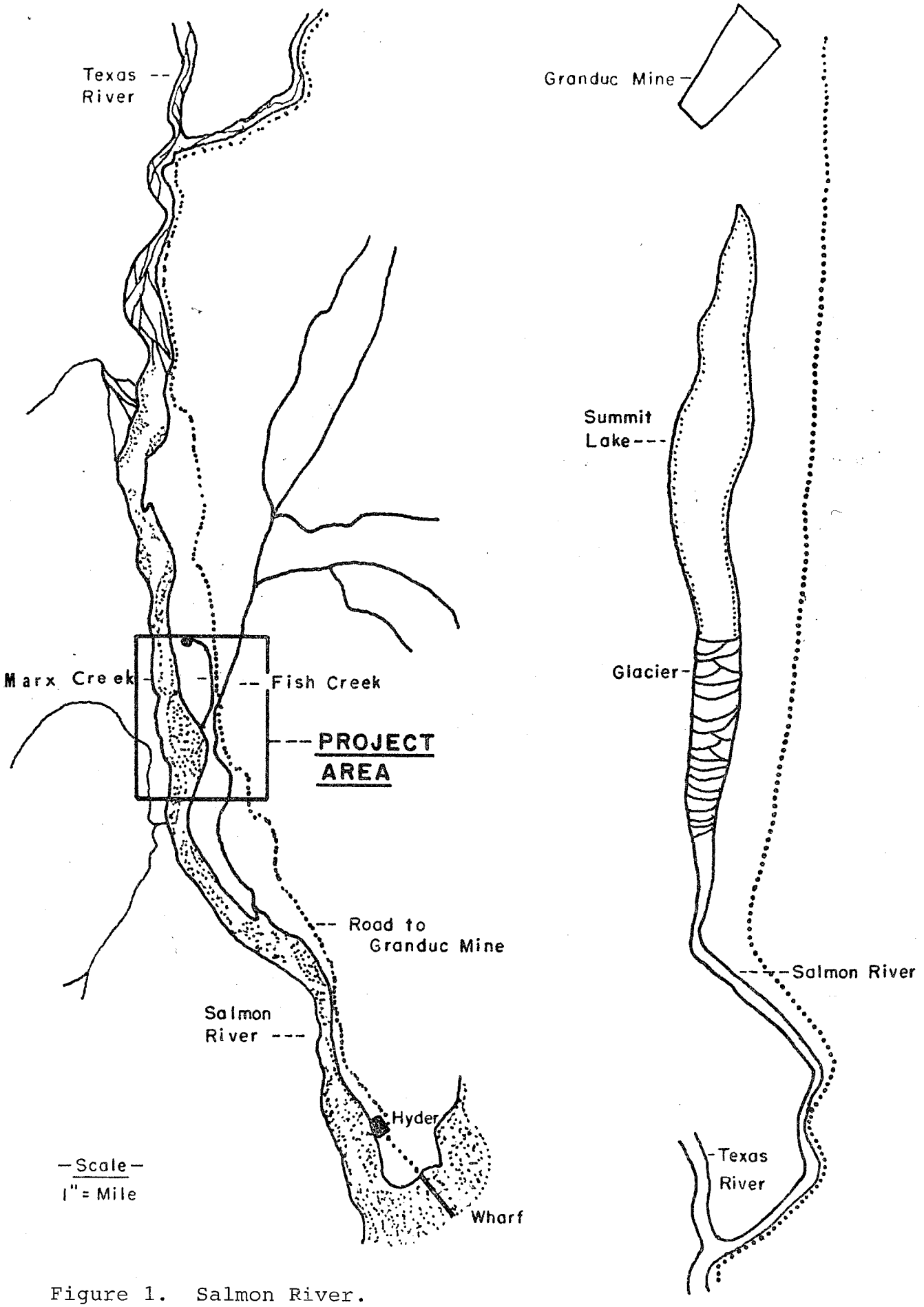

Figure 1. Salmon River.

Stabilization of the watershed resulted from construction of a protective trail dike (Figure 2) around the Fish Creek watershed which keeps the Salmon River annual flood conditions isolated from Fish Creek. Although the construction of the protective dike was in 1974, the fishery assessment and rehabilitation program accelerated in 1977 when the FRED Division secured funding for the Alaska Department of Highways to remove log jams and overburdens of gravel and silt in the historic chum salmon spawning areas of Fish Creek.

The author reported in 1983 that Marx Creek had been created as a result of the trail dike road construction, and that over an 8-year period limited numbers of stray chum salmon from the sister watershed (Fish Creek) were annually spawning in Marx Creek. Streambed reshaping in Marx Creek in 1982 improved flow and gradient characteristics so that improved flushing moved fine materials out of the system. The upwelling ground waters and gravel substrate provided excellent chum salmon environment that was comparable to Fish Creek. In 1983 USFS and FRED cooperatively planned construction of a spawning channel at Marx Creek. Over a two-year period, data on hydrology, design, pathology, and genetics were collected while a budget support system was developed. Actual construction was completed in time for fisheries enhancement work to start in August of 1985.

The spawning channel utilized the streambed channel defined by heavy equipment work completed in 1982. The total length of the Marx Creek spawning channel project is 1,722 m, with an average width of 6.4 m. Prime spawning habitat for chum salmon is found in 1,173 m of the upper channel, which provides 7,511 m^2 of prime spawning area.

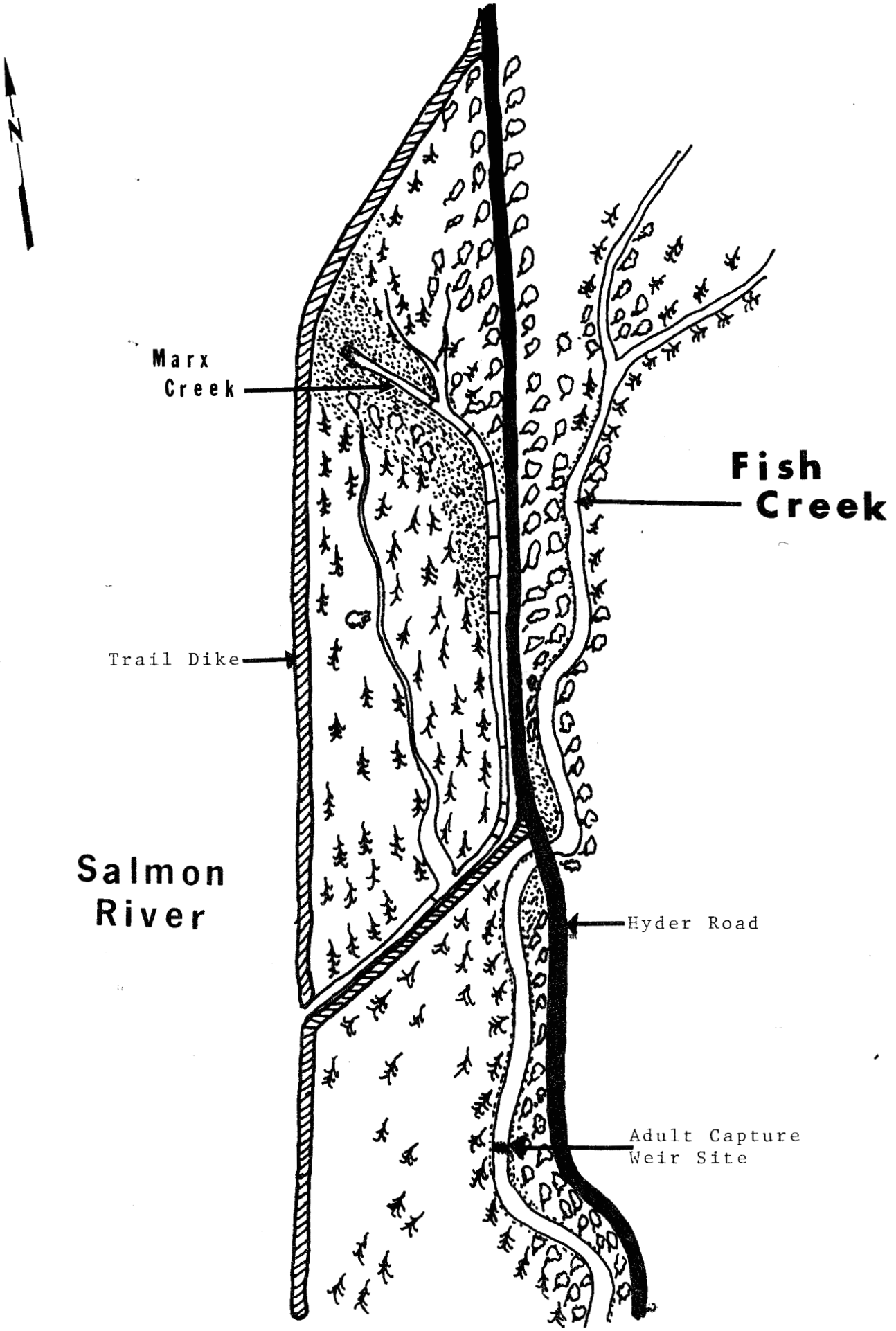

Figure 2. Fish and Marx Creek project area. Not to scale.

METHODS

Channel Design

USFS Fisheries Engineer, Paul Tappel, incorporated side-channel engineering criteria from British Columbia spawning channel reviews in designing the Marx Creek system. Some twelve redwood weirs were constructed of laminated 2- x 6-in pressure-treated lumber. These weirs were placed at varying intervals from 30 m to 305 m. Distance between weir placement was designed to maintain a water depth of 23 cm to 38 cm and maintain in-system velocities between 14 cm-61 cm (0.5 ft-2.0 ft) per second. Elevation at the head end of the channel is 37 m and drops to 32 m, 1.2 km downstream. Both upwelling and lateral-flow characteristics were critical design considerations for optimal chum salmon production conditions. Channel width was improved with heavy equipment; shot-rock armor or riprap was placed along both channel banks to reduce side erosion from spawner activity. The weirs were embedded into the substrate some 0.9 m or more and embedded 1.2 m-1.5 m in each streambank using a backhoe. Both the upstream and downstream sides of the weirs were riprapped on a 2:1 slope from weir top to channel bottom to protect against spawning-activity damage to the weir sites. Weir slots and sills allow the accommodation of different flows and depths because the length of the weir slot increases from 0.3 m to 1.8 m as downstream flows increase.

Fisheries Design

At each of six weirs, a double aluminum I-beam picket fence was constructed across the weirs to maintain transplanted adult chum salmon at a predetermined density per section or cell. A project proposal developed in 1985 by the FRED Division defined a five-year plan to transplant 5,000 adult fish annually, which would potentially deposit 6.25 million eggs. After the transplant cycle is complete, escapement into the system should approach

10,000 adults, which will produce annual egg depositions of 12.5 million. A 25% survival to the fry stage will produce 3.13 million chum salmon fry annually. Fry-to-adult survival is expected to be 1.0% or 31,300 fish.

Pre-emergent fry sampling was planned to determine overwinter survival. A standard backpack pump equipped to inject air into the water jet was used to force pre-emergent fry and eggs from the substrate. The sample was collected within a 0.2-m^2 basket which was fitted with a cloth net funnel. Fry were swept into the secured cod end. Each sample was hand-counted into a plastic tub. Random samples were taken from across the total section or cell. A typical cell had approximately 410 m^2 of substrate and eight samples were made within the cell.

A portion of the emergent fry were captured at night in down-stream fyke nets and held in a holding box (1.2 m x 0.6 m x 0.6 m) until the following day, at which time they were coded-wire-tagged. Tagged fish were held until the dark evening hours and then released after tag retention checks of at least 200 fish were made. A minimum of 20,000 fry are scheduled to be coded-wire-tagged each year for five years to evaluate the project.

Alevin development is to be monitored using temperature unit accumulation and amount of yolk remaining. Timing of emergence is predictable using these techniques. Annually, age-length samples will be collected from the transported adults. The National Marine Fisheries Service (NMFS) is the cooperator in this portion of the program.

Surveys of adult salmon escaping into the lower cells of the spawning channel are seasonally done by several cooperators: USFS, NMFS, the ADF&G Commercial Fisheries Division, and the FRED Division. Surveys cover the entire chum salmon run at both Fish and Marx Creeks. The results from each cooperator are pooled and total escapement is calculated. Constant monitoring of surface

water temperature with Ryan thermographs (Model RTM®) provides long-term, low-maintenance, and reliable data collection. Upwelling water provides the primary water supply for the channel. Contributions to the fisheries will be possible using the Port Sampling Project associated with the ADF&G, Commercial Fisheries Division. Tag data will be processed by the FRED Division Tag Lab. Tag recovery will also occur at Marx Creek where carcass examination is possible. A cooperative U.S./Canada Pacific Salmon Treaty tagging program will supplement the evaluation phase of this project.

We attempted to transplant adults from Fish Creek during the entire run to maintain the same timing and population trend as the donor system. Adult fish were captured in Fish Creek using two standard picket-weir fences. The downstream fence was fitted with a trap throat that allows entry into the area between the upstream and downstream fences. A wire-mesh panel crowder confined the fish for ease of dip netting or hand capture. A 3/4-ton, 4 x 4 pickup equipped with a 757-liter tank and 12-volt aerator was used for transport. Buffered anesthetic (MS-222®), *tricaine methane sulfonate* was added to the transport tank water to facilitate handling, reduce self-inflicted injuries, and slow down metabolism.

RESULTS

Adult Transfer

In 1985 FRED Division set up the picket-weir fences on five of the spawning channel cells. Between 15 and 27 August, project personnel moved 1,904 chum salmon adults. Table 1 defines the results of this first year's transport program. Some 3,199 chum

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Table 1. Transplanted adult results, 1985.

Cell #	Area (m^2)	Number of males	Number of females	Total	M/F sex ratio	Density: sq.m/female
1	817.5	0	0	0	--	--
2	409.0	196	201	397	0.98:1	2.03
3	409.0	200	200	400	1.00:1	2.05
4	427.3	228	222	450	1.03:1	1.92
5	410.0	194	200	394	0.97:1	2.05
6	410.1	148	115	263	1.29:1	3.57
		966	938	1,904	($\bar{x}$) 1.05:1	($\bar{x}$) 2.32

salmon adults (Table 2) were transplanted in 1986 into six cells. The second year's operations moved fish between 9 August and 9 September 1986.

The adults were successfully transported in anesthetized water using the 757-liter tank mounted in a 4 x 4 pickup. Depending upon loading time, the normal transport time averaged about 20 minutes. Water and anesthetic were changed after the second load. The anesthetized fish fully recovered within 2-4 minutes; no mortalities occurred either year from the transport and handling procedure.

Females were observed digging redds within 2 hours after transport. Characteristically, the fish moved into the center of the spawning area after recovery from the MS-222 and then females moved out of the mass of fish and began spawning-site selection and preparation. Males appeared to school longer than the females. Females vying for spawning sites as well as male aggressive behavior coincided with the females' readiness to spawn. Spawning was generally complete for each cell 4-5 days after planting time. Spawning periods were directly influenced by the time required to collect, transport, and complete stocking of each cell. Spawners were assumed to be within a day or two of ripeness, as eggs would spill from the females if not properly handled. Extreme care was taken to control egg loss.

Spawned-out fish remained healthy and active in the cells for longer post-spawning times than the same stock in Fish Creek. Body deterioration was less and retention of bright coloration was greater than expected, suggesting that the bacterial and fungal load was not as high as in historically productive salmon streams. This condition was again observed in 1986, where stream life in the channel exceeded 16 days. Post-spawning stream life for Fish Creek stocks were expected to be 5-7 days. Total stream life for the Marx Creek-transplanted chum salmon may approach 30 days.

Table 2. Transplanted chum salmon adult results, 1986.

Cell #	Area (m^2)	Number of males	Number of females	Total	M/F sex ratio	Density: sq.m/female
1	817.5	230	240	470	1:1.04	3.41
2	409.0	273	273	546	1:1	1.50
3	409.0	273	273	546	1:1	1.50
4	427.3	273	273	546	1:1	1.57
5	410.0	273	273	546	1:1	1.50
6	410.1	237	308	545	1:1.3	1.33
		1,559	1,640	3,199	($\bar{x}$) 1:1.05	($\bar{x}$) 1.80

Pre-Emergent Sampling

On 19 March 1986, project staff sampled each cell that had been stocked in August 1985. Pre-emergent sample gear previously described was used. Samples based on total area/cell were collected from each of the controlled cells.

The results of this pre-emergent sampling operation are presented in Table 3. On 23 and 24 March 1987, the study area was again sampled with pre-emergent gear using standards established in 1986. Results are presented in Table 4.

Fecundity studies have not been incorporated into this project; therefore, based on studies of other Southeastern chum salmon stocks at FRED Division hatcheries, it is estimated these stocks will have a fecundity of 2,500 eggs per female.

Brood Year 1985

Incubation Survival:

Survival from green-egg deposition to emergent fry was 19.4%. Survival varied between cells and may be related to fine material bed loads in the respective cells. A hard-pack zone located approximately 15 cm below the surface of the substrate extended approximately 10 cm-15 cm. Dead eggs and fry normally came from this zone. Live fry were found below and above this fine material zone.

Of the total mortality, 74.2% occurred in the egg stage and 25.8% in the alevin stage. This condition of survival was considered normal in comparison to other life-history studies of salmon in streams across Alaska.

Percent yolk retention of fry from both the Marx Creek spawning channel and Fish Creek in 1986 was estimated (Table 5).

Table 3. Pre-emergent chum salmon sampling results, 1986.

Cell #	Sample number	Live chum fry	Dead chum fry	Dead chum fry	Potential[a/] deposition (x 1,000)	Survival egg-fry (%)
1	0	--	--	--	--	--
2	8	184,050	26,841	6,646	502.5	36.6
3	8	96,881	15,849	1,023	500	19.4
4	8	58,896	8,436	6,391	555	10.6
5	8	18,405	12,526	2,300	500	3.7
6	8	95,859	38,088	1,278	287.5	33.3
		454,091	101,740	17,638	2,345	20.7

Table 4. Pre-emergent chum salmon sampling results, 1987.

Cell #	Sample number	Live chum fry	Dead chum fry	Dead chum fry	Potential[a/] deposition (x 1,000)	Survival egg-fry (%)
1	16	138,464	12,773	0	600.0	23.1
2	8	160,804	62,373	767	682.5	23.6
3	8	247,213	75,154	23,006	682.5	36.2
4	8	141,810	34,427	267	682.5	20.8
5	8	165,834	256	16,404	682.5	24.3
6	8	189,159	256	60,219	770.0	24.6
		1,043,284	185,239	100,663	4,100.0	($\bar{x}$) 25.4

[a/] Assumed that fecundity is 2,500.

Table 5. Percent yolk in chum salmon alevins, Marx Creek, 1986.

Cell #	Sampling Dates 3/19	4/17	5/20	Days of incubation
1	--	--	--	
2	17.2	13.6	--	212/241
3	14.9	27.5	3.9	209/238/271
4	16.7	--	5.3	210/272
5	--	18.7	2.1	238/271
6	--	--	--	--
[a/]	16.2	20.9	4.9	

[a/] Weighted average.

Temperature-monitoring stations were established using Ryan 60-day thermographs® on 18 March 1986. Prior to this time water temperature regimes were undocumented. Various investigators occasionally checked temperatures at Fish Creek as they enumerated escapement; occasional temperature checks were made at Marx Creek and appear in Tables 6a and 6b and Figure 3.

Between 28 May 1986 and 5 June 1986, emergent chum salmon fry were collected in a fyke net. Trapping occurred during the evening hours. A portion of the fry were held for coded-wire tagging operations which commenced the following mornings at 8:00 a.m. and continued throughout the day. The remainder of the fry passed through an electronic fish counter developed by Northwest Marine Technology, Incorporated®. The counter was being field-tested intermittently, so incomplete emigrant data resulted; however, the electronic counter proved to be a reliable field tool. General observations on emigrant activity indicated that migration occurred during all periods of the day with a definite increase in numbers of fish moving at dusk, usually between 6:00 p.m. and 7:00 p.m., but activity dropped off for 2-3 hours before starting peak migrations between 10:00 p.m. and 11:00 p.m. Fry continued to move out during the dark hours of the evening and dropped off toward morning.

Evaluation

Coded-wire tagging in 1986 commenced on 28 May and ended on 6 June. Fish captured in the downstream fry trap were held in an attached holding box until 8:00 a.m.; they were then moved to a holding net (1.8 m x 1.2 m x 0.9 m) anchored in the channel next to the tagging facilities. A mobile trailer (6.1 m x 2.4 m) was converted into tagging quarters and electrical power was supplied by a 2,500-watt Honda generator®. A total of 29,936 fish were tagged in 33.8 hours. The tagging rate was 886 fish per hour. The three tag codes were as follows:

Table 6a. Marx Creek spawning channel 1986 water temperature data collected at weirs 3 and 4.

Date	°C	Date	°C	Date	°C
3/13	2.4	6/05	2.5	8/30	4.5
3/16	2.5	6/08	3	9/02	4.5
3/19	2.5	6/11	3.5	9/05	4.5
3/21	2.5	6/14	3	9/08	4.5
3/24	2.5	6/17	3	9/11	4.5
3/27	2.5	6/20	3.5	9/14	4
3/30	2.5	6/23	3.5	9/17	4
4/02	2.5	6/27	3.5	9/20	4
4/05	2.5	6/30	3.5	9/23	4
4/08	2.5	7/03	3.5	9/27	4
4/11	2.5	7/07	3.5	9/30	4
4/14	2.5	7/10	3.5	10/03	4.5
4/17	2	7/13	3.5	10/06	4
4/20	2	7/16	4	10/09	4
4/23	1.5	7/19	4	10/12	4
4/26	1.5	7/21	4	10/15	4
4/29	1.5	7/24	4	10/18	4
5/02	2	7/27	4	10/21	4.5
5/05	2	7/30	4	10/24	4.5
5/08	2	8/02	4	10/27	4.5
5/11	2	8/05	4.5	10/30	4.5
5/14	2	8/08	4.5	11/02	4.5
5/17	2	8/11	4.5	11/05	4.5
5/20	2	8/14	4.5	11/08	4
5/23	2	8/17	4.5	11/11	4
5/27	2	8/20	4.5	11/14	4
5/30	2	8/23	4.5	11/17	4
6/02	2.5	8/27	4.5	11/20	4

Table 6b. Historical water temperature data for Marx and Fish Creeks.

Date	Location	Temperature
8/25/82	Marx Creek surface/intergravel	7°C
9/08/82	Fish Creek - right fork	10°C
9/08/82	Fish Creek - left fork	
9/09/82	Lower spawning area - Fish Creek	7°C
10/26/82	Fish Creek bridge	7°C
10/26/82	Fish Creek - right fork	7°C
10/26/82	Fish Creek - left fork	8°C Ambient 5.5°C
10/26/82	Marx Creek - cell #2 area	7°C
8/27/86	Fish Creek - bridge	6°C
8/28/86	Marx Creek - cell #4	4.4°C
4/16/86	Marx Creek - cell #4	1.6°C
4/17/86	Marx Creek - cell #4	1.6°C
3/19/86	Marx Creek - cell #4	1.1°C Hardness 60 ppm
5/20/86	Marx Creek - cell #4	3.5°C
9/23/85	Marx Creek channel (surface)	4.6°C-4.8°C
9/23/85	Marx Creek channel (intergravel)	3.0°C-4.9°C
10/10/85	Marx Creek channel (surface)	4.7°C
10/10/85	Marx Creek channel (intergravel)	4.2°C
10/01/86	Marx Creek channel (surface)	5.3°C
10/01/86	Marx Creek channel (intergravel)	4.6°C

by Jack Helle.

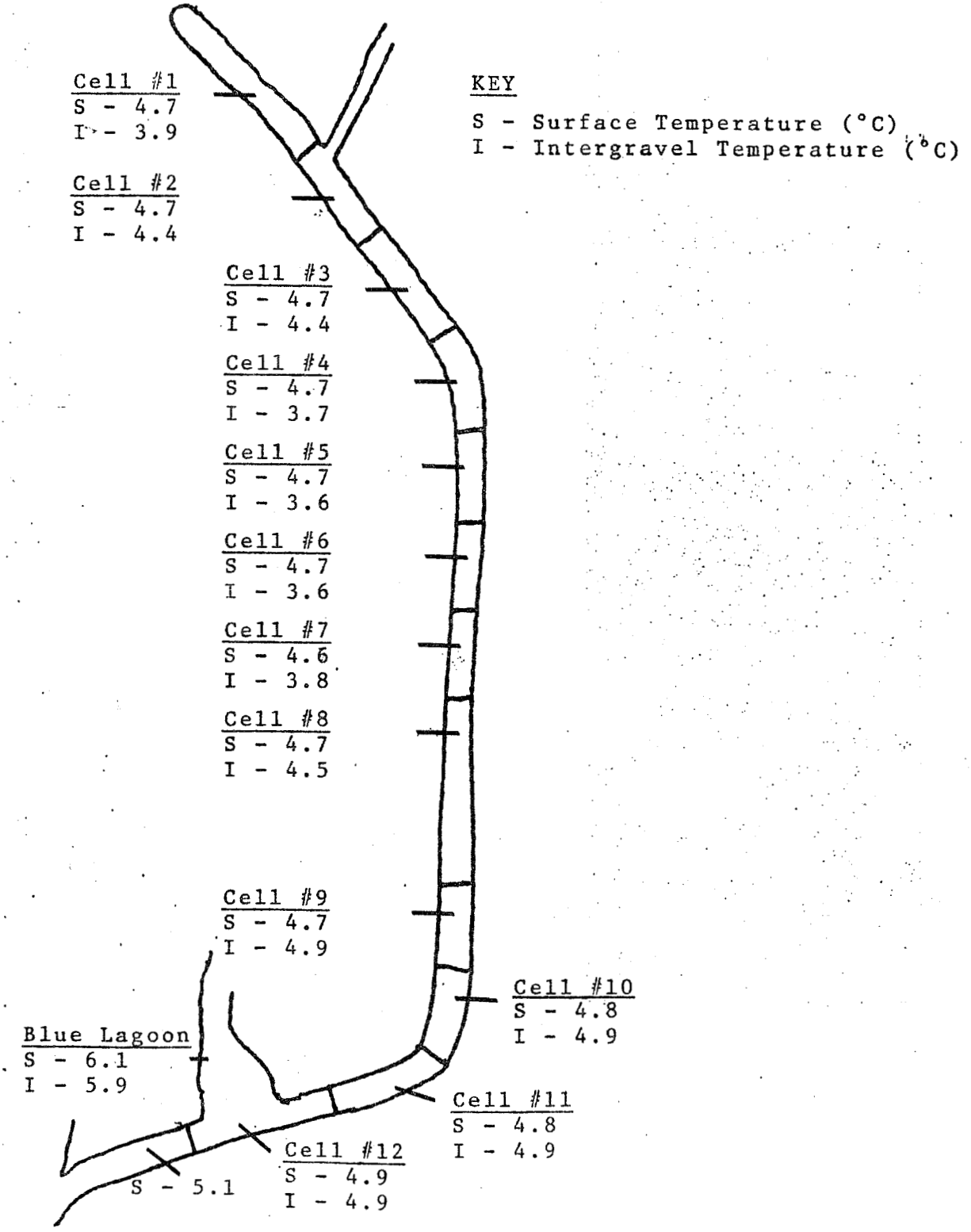

Figure 3. Marx Creek temperature survey, 23 September 1986.

Tag retention was 90.5%, which is good considering that the average size of the fish was about 0.3g and 38.7mm in length. A total of 104 tagging mortalities occurred in 1986 resulting in a 0.3% mortality rate. The validly tagged fish released numbered 26,892.

The usual tagging crew consisted of four people with tagging occurring over a nine-day period.

Brood Year 1986

Incubation Survival:

Survival from green-egg deposition to emergent fry was 25.4%. Variation in survival rates between cells was evident but was not as wide a range as in the 1985 brood. Fine material continued to persist in cells 4, 5, and 6, where a hard-packed zone influenced upwelling flow regimes. Of the total mortality from green egg to emergent fry, 64.8% occurred in the egg stage, but was proportionally lower than the 1985 brood year results. Approximately 35.2% of the mortality was in the alevin stage and was higher than in the preceding year. The ratio of dead eggs to dead fry in cells 5 and 6 possibly best reflect the differences between brood year mortalities and the impact of the fine material layer in cells parallel to the Hyder roadbed. Airborne fine materials from the road traffic continually affect survival during the fry stage of development.

Percent yolk retention samples for fry were again collected at Marx Creek in 1987. The results are found in Table 7. In order to develop an index to predict emergence, this segment of the project will continue.

Table 7. Percent yolk in chum salmon alevins, Marx Creek, 24 March 1987.

Cell #	L (mm)	W (g)	Yolk (% body wt)	Days of incubation
1	32	0.34	29.5	224
2	34	0.39	32.7	214
3	35	0.37	16.2	212
4	35	0.35	12.9	210
5	34	0.36	20.3	209
6	33	0.41	30.6	197
	$\bar{x}$ 34	0.37	23.7	

Emergent chum salmon fry-trapping and coded-wire tag operations started on 4 May 1987 and continued through 10 May 1987. The trapping and tagging operation was handled in the same fashion as in 1986.

Evaluation

In 1987 tagging commenced on 4 May and ended on 10 May. The same procedures utilized in 1986 were used in 1987 tagging operations. The results of daily tagging operations are found in the Appendix. A crew of four tagged 30,486 fry in seven days. The crew accomplished this task in 35 tagging hours for a tagging rate of 861 fish per hour. Only one tag code was applied: 3B-15-2.

Tag retention was 97.25%, which is excellent considering that the size of the fish was 0.3 g in weight and 39.7 mm in length. Only 98 mortalities were attributed to coded-wire tagging operations, which is consistent with the 0.3% mortality rate of 1986.

DISCUSSION

The 1985 and 1986 brood year chum salmon program at the Marx Creek spawning channel went very well and defined some changes that will be addressed in future years of operation. Water temperature data are inadequate to assist in making fry-development predictions. Reliable long-term recording thermographs were not available until March 1987. Personal computer-compatible Ryan recorders (Model RTM®) will help monitor the surface water temperature on a constant basis over several years of operation. Utilizing the sporadic temperature recordings, we should have had emergence occurring in late June 1986, but this was not the case. Emergence probably began in mid-May even though the estimate of potential temperature units accumulated were less that those needed for chum salmon stocks to emerge at Beaver Falls and Klawock Hatcheries where emergence occurred between 840-950

Klawock Hatcheries where emergence occurred between 840-950 temperature units (TU) and 800-1100 TUs, respectively.

Percent yolk retention data are presented as information to the reviewer, but analysis from this first two years of limited data collection does not produce obvious correlations. The increase in percent of yolk material for alevins in cell #3 between 3 March and 17 April 1986 may be an artifact of preparation of the samples or may be actual effects of varying proportions of upwelling water and surface-flow water in different cells. Emergence size was considered similar to other chum salmon stocks in southeast Alaska. Survival from egg to outmigrant fry was 19.8% and 25.4%. As the fine materials are moved out of the channel by spawning activities, survival may improve. The original design required washed and screened gravel to be laid down as substrate. Unfortunately, USFS budget reductions eliminated this design criterion. Naturally occurring substrate was left in place. Fine particulate substrate decreased survival, especially in those cells closely paralleling the road system. Because the road served as a truck-transport system for copper ore, large amounts of fine airborne particles settled into the gravel-cobblestone material that eventually became the substrate for the spawning channel.

RECOMMENDATIONS

1. Continue to increase the loading rate of females/m^2 of available substrate until a decrease in survival is monitored.

2. Mechanically disturb the channel substrate with heavy equipment to enhance the flushing out of the fine material.

3. Decrease the height of the weirs during periods of salmon absence to enhance fine material flushing.

4. Conduct an abatement program for dust coming from the road paralleling the spawning channel. Current increases in the tourist and mining industry's use of the road may quickly return the airborne fine material to the 1970's problem level.

ACKNOWLEDGMENTS

The authors would like to recognize the following people for their efforts to accomplish the construction of the Marx Creek spawning channel and assistance in development of the fisheries program at the site.

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Larry Marx, Hyder resident
Don Marx, deceased Hyder resident for whom the spawning channel is named

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REFERENCES

Helle, John H. 1978. Age and size of some populations of chum salmon in North America. Proceedings of the International Conference on Biology of Pacific Salmon. NOAA, National Marine Fisheries Service, Auke Bay, Alaska.

Novak, Paul. 1983. Stream and fisheries rehabilitation activities at Fish Creek--Hyder. Alaska Department of Fish and Game, FRED Report Series No. 7. 21 p.

Tappel, Paul. 1985. Personal communications and U.S. Forest Service project files. U.S. Forest Service, Ketchikan, Alaska.

APPENDIX

ALASKA DEPARTMENT OF FISH AND GAME (FRED)
TAGGING SUMMARY AND RELEASE INFORMATION

WIRE SAMPLE (ONE/SPOOL)

CODED WIRE TAG SUMMARY SHEET

Species (common name) Chum
Brood Year 1985
Stock Fish Creek
Facility Marx Creek-remote
Lot Number

Tag Code (one/sheet) 3B-12-3
Supervisor Denton
Study (experimental or production lot; describe briefly) Spawning Channel Production

Date Mo./Day/Yr.	Machine Number	Number Fish Tagged	Time (hrs.)	Tag Rate (fish/hr)	% Tag* Retention	Sample Ratio	Total Valid Tagged	Tagged Morts
06/03/86	235	694	0.6	1,157	83.2	168/202	577	1
06/04/86	235	4,743	4.1	1,157	90	182/203	4,269	7
06/05/86	235	4,148	4.6	902	85.5	171/200	3,547	2
/ /						/		
/ /						/		
/ /						/		
Total/ Averages		9,585	9.3	1,031				10

NOTES:

Size of fish when tagged: 0.3 grams

Number of fish with naturally missing adipose fins 0

*Determined from a sample size of 200 tagged fish/machine/day.

RELEASE SAMPLING INFORMATION

A Date of Release Mo./Day/Yr.	B Mortalities of Tagged Fish: During Tagging	B Mortalities of Tagged Fish: After Tagging	C Tag Retention Sample Ratio	D % Tag Retention of Code (from C)**	E Number of Tagged Fish Released (Total # Tagged minus Total Tagged Mortalities)	F Number Valid Tagged Fish Released (% Tag Retention x # of Tagged Fish Released)	G Number Fish Released Ad-clipped but Rejected CWTag	H Number of Fish Released Not Marked but Represented by Code
/ /	10		/		9,575	8,384	1,191	

I Total Number Fish Released	J Date of Tag Test		K Total Kg Released	L Size: fish/kg	grams/fish	mean fork length (mm)
		TAGGED				
		UNTAGGED				

NOTES: Site of release Marx Creek
Time of release Day of Tagging-dark
Stage of tide N/A
Condition of fish
Supervisor of release Novak

**Determined from a sample size of 500 tagged fish/code on release.

rev. 8/81

ALASKA DEPARTMENT OF FISH AND GAME (FRED)
TAGGING SUMMARY AND RELEASE INFORMATION

WIRE SAMPLE (ONE/SPOOL)

CODED WIRE TAG SUMMARY SHEET

Species (common name) Chum
Brood Year 1985
Stock Fish Creek
Facility Marx Creek - remote
Lot Number

Tag Code (one/sheet) 3B-12-1
Supervisor Ward
Study (experimental or production lot; describe briefly) spawning channel production

Date Mo./Day/Yr.	Machine Number	Number Fish Tagged	Time (hrs.)	Tag Rate (fish/hr)	% Tag* Retention	Sample Ratio	Total Valid Tagged	Tagged Morts
05/28/86	286	1,718	2.58	666	94.5			15
05/29/86	286	4,277	5.0	855	89.5			43
05/30/86	286	3,907	4.9	797	97.5			21
/ /								
/ /								
/ /								
Total/ Averages		9,902	12.48	793				79

NOTES:

Size of fish when tagged: 0.3 grams

Number of fish with naturally missing adipose fins

*Determined from a sample size of 200 tagged fish/machine/day.

RELEASE SAMPLING INFORMATION

A Date of Release Mo./Day/Yr.	B Mortalities of Tagged Fish: During Tagging	B Mortalities of Tagged Fish: After Tagging	C Tag Retention Sample Ratio	D % Tag Retention of Code (from C)**	E Number of Tagged Fish Released (Total # Tagged minus Total Tagged Mortalities)	F Number Valid Tagged Fish Released (% Tag Retention x # of Tagged Fish Released)	G Number Fish Released Ad-clipped but Rejected CWTag	H Number of Fish Released Not Marked but Represented by Code
/ /	79				9,823	9,188	635	

I Total Number Fish Released	J Date of Tag Test		K Total Kg Released	L Size: fish/kg	grams/fish	mean fork length (mm)
		TAGGED				
		UNTAGGED				

NOTES: Site of release Marx Creek
Time of release Day of Tagging-dark
Stage of tide N/A
Condition of fish
Supervisor of release Novak

**Determined from a sample size of 500 tagged fish/

ALASKA DEPARTMENT OF FISH AND GAME (FRED)
TAGGING SUMMARY AND RELEASE INFORMATION

WIRE SAMPLE (ONE/SPOOL)

CODED WIRE TAG SUMMARY SHEET

Species (common name) Chum
Brood Year 1985
Stock Fish Creek
Facility Marx Creek - remote
Lot Number

Tag Code (one/sheet) 3B012-2
Supervisor Denton
Study (experimental or production lot; describe briefly) Spawning Channel Production

Date Mo./Day/Yr.	Machine Number	Number Fish Tagged	Time (hrs.)	Tag Rate (fish/hr)	% Tag* Retention	Sample Ratio	Total Valid Tagged	Tagged Morts
06/01/86	286	723	1.5	482	94	189/201	680	0
06/02/86	286	220	0.25	880	94	188/200	207	0
/ /	235	4,976	5.25	948	94	188/200	4,677	5
06/03/86	235	4,530	5.0	906	83.2	168/202	3,769	10
/ /						/		
/ /						/		
Total/ Averages		10,449	12.0	871				15

NOTES:

Size of fish when tagged: 0.3 grams

Number of fish with naturally missing adipose fins 0

*Determined from a sample size of 200 tagged fish/machine/day.

RELEASE SAMPLING INFORMATION

A Date of Release Mo./Day/Yr.	B Mortalities of Tagged Fish: During Tagging	B Mortalities of Tagged Fish: After Tagging	C Tag Retention Sample Ratio	D % Tag Retention of Code (from C)**	E Number of Tagged Fish Released (Total # Tagged minus Total Tagged Mortalities)	F Number Valid Tagged Fish Released (% Tag Retention x # of Tagged Fish Released)	G Number Fish Released Ad-clipped but Rejected CWTag	H Number of Fish Released Not Marked but Represented by Code
/ /	15		/		10,434	9,320	1,114	

I Total Number Fish Released	J Date of Tag Test		K Total Kg Released	L Size: fish/kg	grams/fish	mean fork length (mm)
		TAGGED				
		UNTAGGED				

NOTES: Site of release Marx Creek
Time of release Day of Tagging-dark
Stage of tide N/A
Condition of fish
Supervisor of release Novak

**Determined from a sample size of 500 tagged fish/ code on release.

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ALASKA DEPARTMENT OF FISH AND GAME (FRED)
TAGGING SUMMARY AND RELEASE INFORMATION

WIRE SAMPLE (ONE/SPOOL)

CODED WIRE TAG SUMMARY SHEET

Species (common name) Chum Salmon
Brood Year 1986
Stock Marx Creek(Fish Cr. Sal. R)
Facility
Lot Number

Tag Code (one/sheet) 3B-15-2
Supervisor Denton
Study (experimental or production lot; describe briefly) Evaluate Spawning channel production

Date Mo./Day/Yr.	Machine Number	Number Fish Tagged	Time (hrs.)	Tag Rate (fish/hr)	% Tag* Retention	Sample Ratio	Total Valid Tagged	Tagged Morts
5/04/87	254	2,581			99.5	199/200	2,556	2
5/05/87	254	5,013			96.5	193/200	4,818	2
5/06/87	254	4,727			98.0	198/202	4,618	5
5/07/87	254	5,200			95.0	190/200	4,925	1
5/08/87	254	5,162			96.0	192/200	4,926	16
/ /						/		
Total/ Averages								

NOTES:

Size of fish when tagged: 0.3 grams

Number of fish with naturally missing adipose fins

Tag retention determined @10:00 p.m. same day as tagged.

*Determined from a sample size of 200 tagged fish/machine/day.

RELEASE SAMPLING INFORMATION

All fish released @10:30 p.m. same day as tagged.

A Date of Release Mo./Day/Yr.	B Mortalities of Tagged Fish: During Tagging	B Mortalities of Tagged Fish: After Tagging	C Tag Retention Sample Ratio	D % Tag Retention of Code (from C)**	E Number of Tagged Fish Released (Total # Tagged minus Total Tagged Mortalities)	F Number Valid Tagged Fish Released (% Tag Retention x # of Tagged Fish Released)	G Number Fish Released Adclipped but Rejected CWTag	H Number of Fish Released Not Marked but Represented by Code
/ /	27	98*	/	97.25		30,486	916	

I Total Number Fish Released	J Date of Tag Test		K Total Kg Released	L Size: fish/kg	L Size: grams/fish	L Size: mean fork length (mm)
		TAGGED	9.42	3333	0.3	39.7
		UNTAGGED		3333	0.3	39.7

*See attached sheet

NOTES: Site of release Marx Creek
Time of release Daily
Stage of tide N/A
Condition of fish Excellent
Supervisor of release Novak

**Determined from a sample size of 500 tagged fish/code on release.

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ALASKA DEPARTMENT OF FISH AND GAME (FRED)
TAGGING SUMMARY AND RELEASE INFORMATION

WIRE SAMPLE (ONE/SPOOL)

CODED WIRE TAG SUMMARY SHEET

Species (common name) Chum Salmon
Brood Year 1986
Stock Marx Creek(Fish Cr. Sal R.)
Facility
Lot Number

Tag Code (one/sheet) 3B-15-2
Supervisor Denton
Study (experimental or production lot; describe briefly) Evaluate Spawning Channel production.

Date Mo./Day/Yr.	Machine Number	Number Fish Tagged	Time (hrs.)	Tag Rate (fish/hr)	% Tag* Retention	Sample Ratio	Total Valid Tagged	Tagged Morts
5/09/87	254	5,758			98.5	197/200	5,658	1
5/10/87	254	3,085			97.25*		2,985	0
/ /								
/ /								
/ /								
/ /								
Total/ Averages		31,527						

NOTES:

Size of fish when tagged: 0.3 grams

Number of fish with naturally missing adipose fins

* $\bar{x}$ of all previous retention checks.

*Determined from a sample size of 200 tagged fish/machine/day.

RELEASE SAMPLING INFORMATION

A Date of Release Mo./Day/Yr.	B Mortalities of Tagged Fish: During Tagging	B Mortalities of Tagged Fish: After Tagging	C Tag Retention Sample Ratio	D % Tag Retention of Code (from C)**	E Number of Tagged Fish Released (Total # Tagged minus Total Tagged Mortalities)	F Number Valid Tagged Fish Released (% Tag Retention x # of Tagged Fish Released)	G Number Fish Released Adclipped but Rejected CWTag	H Number of Fish Released Not Marked but Represented by Code
/ /								

I Total Number Fish Released	J Date of Tag Test		K Total Kg Released	L Size: fish/kg	L Size: grams/fish	L Size: mean fork length (mm)
		TAGGED				
		UNTAGGED				

NOTES: Site of release
Time of release
Stage of tide
Condition of fish
Supervisor of release

**Determined from a sample size of 500 tagged fish/

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